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## TRAINING FUTURE TEACHERS OF INFORMATION SCIENCE TO DEVELOP LOGICAL THINKING SKILLS OF SENIOR SCHOOLCHILDREN AT TEACHING SOFTWARE DEVELOPMENT

**Introduction.** The application and development of modern technologies in all spheres of social life in Ukraine causes the increase of educational branch role for training and educating the young generation. Moreover, the teaching of Information Science and information a communication technology (ICT) to schoolchildren is becoming one of the prior directions at forming the personality of a secondary school (SS) leaver.

The aim of professional pedagogical training of Information Science teacher has to be in accordance with the general tasks of teaching, education and developing the personality of future specialist. These tasks are, first of all, conditioned by the transition to new information society.

**The analysis of the references on psychology and pedagogics alongside with the results of scientific researches** gave the possibility to highlight the following aspects of training the future teachers of Information Science: forming knowledge, skills and abilities of a future teacher of Information Studies (N.Balyk, V.Bykov, L.Breskina, Y.Goroshko, A.Gurzhiy, M.Zhaldak, N.Morze, S.Rakov, Y.Ramskyi, Z.Seidametova, S.Semerikov, O.Sirin, Y.Tryus and others); the methods of software development teaching (N.Morze, Z.Seidametova); the development of algorithmic way of thinking (O.Kopaev).

**The methods of the research:** *theoretical* (analysis, comparison, classification, systematization, generalization) are for the study of scientific literature on the problem of the research, finding the essence and structure of professional pedagogic training of future Information Science teachers to develop logical thinking skills of senior schoolchildren.

**Results.** The modern stage of society development is featured by the implementation of a new system of education and science of Ukraine. This new system implies the transition of Ukrainian education system to Bologna processes and requires the scientific search of improved methods of teaching and educating the future professionals. Therefore, such methods should combine modern information and communication means and techniques of teaching as well as the personal development of learners. There appears an urgent problem of reforming the national system of education which has to be targeted at informatization, automation and application of the newest technologies of teaching. All mentioned above will provide the future professionals with the latest and the most demanded information; will form the competent personality of a teacher, will encourage the specialists to continuous study and self-fulfillment. Moreover, it will contribute much to their promotion and mobility in the conditions of modern information society.

The regulation documents highlight the increasing of creative activity of the future teachers at professional training as one of the main ways to solve this problem. Namely, the training of Information Science teachers has to be focused on the development of logical skills of senior schoolchildren because it will increase the significance of the material learned, schoolchildren will benefit from learning by new ways of cognition and a teacher will obtain the experience of creative activity.

The modern conditions of a *teacher training* require his/her personal qualities actualization as well as the functioning as the main subject of education process organization. It can come true, if the dual goal is achieved: the improvement of the traditional forms and

method of teaching to increase the effectiveness of education process, the development of individual ways of training the students to think logically. It will facilitate forming the readiness of the future professionals for their teaching Information Science at secondary school.

Therefore, the level of training the future teachers of Information Science depends on development of new approaches to design new components of methodological system of teaching at high school. It is recommended to take into consideration humanistic ideas and reference points targeted at providing the opportunities of familiarization and trial the proposed methodological system of training the future teachers of Information Science to develop the skills of logical thinking of senior schoolchildren.

In his study, G. Lavreshina emphasizes that for the presence of logical thinking in the individual, the following components are necessary [2]:

- abilities: to formulate and take over alternative hypotheses; to separate logical operations from those objects over which they are carried out, to make their own opinion the subject of analysis; classify the statements according to their logical type;
- Ability: to define the already known concept; to carry out formal-logical operations; check the correctness of the reasoning, reveal a gross logical error;
- knowledge: the content of the conjunctions of "and", "or", "no" and phrases "if ... then", "then and only when ..." as logical connections; meanings and skills of correct use of phrases "no less" and "no more", "one and only one"; rules of classification [2].

The main objective of learning the part “The basics of Algorithmization and Software Development” within the course of Information Studies is to form the skills of developing algorithms. These skills help to develop logical thinking of schoolchildren. The schoolchildren learn how to perform such mental operations as synthesis, analysis, comparison while developing algorithms to task solution. They also learn how to describe the plan of the actions, to make conclusions; to present the ideas in strict logical sequence.

Fig. 1 demonstrates the scheme of the stages at training future teachers of Information Science to develop logical thinking skills of senior schoolchildren. One can also see the sequence of these stages and its element interconnection. The implementation of this scheme is done step-by-step in accordance with successive execution of each step (see. Fig. 1). Let us characterize every stage in detail.

**I stage. Mastering general scheme of solving software development tasks.**

The general scheme of solving software development tasks includes:

- I. The task assignment (setting input and output parameters).
- II. The description of the algorithm (the development of a mathematical task algorithm (if

needed), the verbal description of the algorithm with further flow-chart description).

III. Program development (the algorithm description with a programming language).

IV. Quality assurance of the program (the development of tests to test the program).

V. The program applying.

Let's consider each component of this algorithm in detail on the example of one task.

**Task 1.** Calculate the area of the triangle by the known three sides.

I. Formation of the problem. In order to compile and implement the algorithm for computing the area of the triangle on three sides, it is necessary to determine the input and output parameters in accordance with the given task condition and, if necessary, to elaborate the condition of the task: to determine which data are permissible; under what conditions it is possible to obtain admissible results, and in which - no; which results will be considered correct.

In this case, the input parameters will be the sides of the triangle a, b, c, the output - area S. Moreover, all (input and output) data should be positive, and necessarily must be the inequality of the triangle for each side: any side of the triangle is smaller for the sum of the other two.

It is clearly seen that at this stage, such thoughtful operations as analysis and synthesis, abstraction, as well as the ability to allocate essential properties of objects that promote the development of logical thinking develop well.

II. Description of the algorithm, which in turn is divided into two stages:

1) construction of a mathematical model of the problem, choice of method for solving a problem, etc.:

As is known from the course of mathematics, the area of the triangle by the known three sides is calculated by the formula of Geron:

$$S = \sqrt{p(p-a)(p-b)(p-c)}.$$

At this stage, the ability to find the main connections and the relation of objects and phenomena of the surrounding reality develop, which is a prerequisite for the development of logical thinking.

2) description of the algorithm verbally and using a block diagram:

We compile a block diagram (see Fig. 2) according to the described verbal algorithm.

At this stage, we are developing such skills as constructing an algorithm, without which the development of logical thinking is not possible.

After drawing up the flowchart, we proceed to the next stage.

III. Drafting of the program: writing a program in the programming language C ++ (to compile the program in a certain programming language, you need to have the necessary (basic) knowledge).

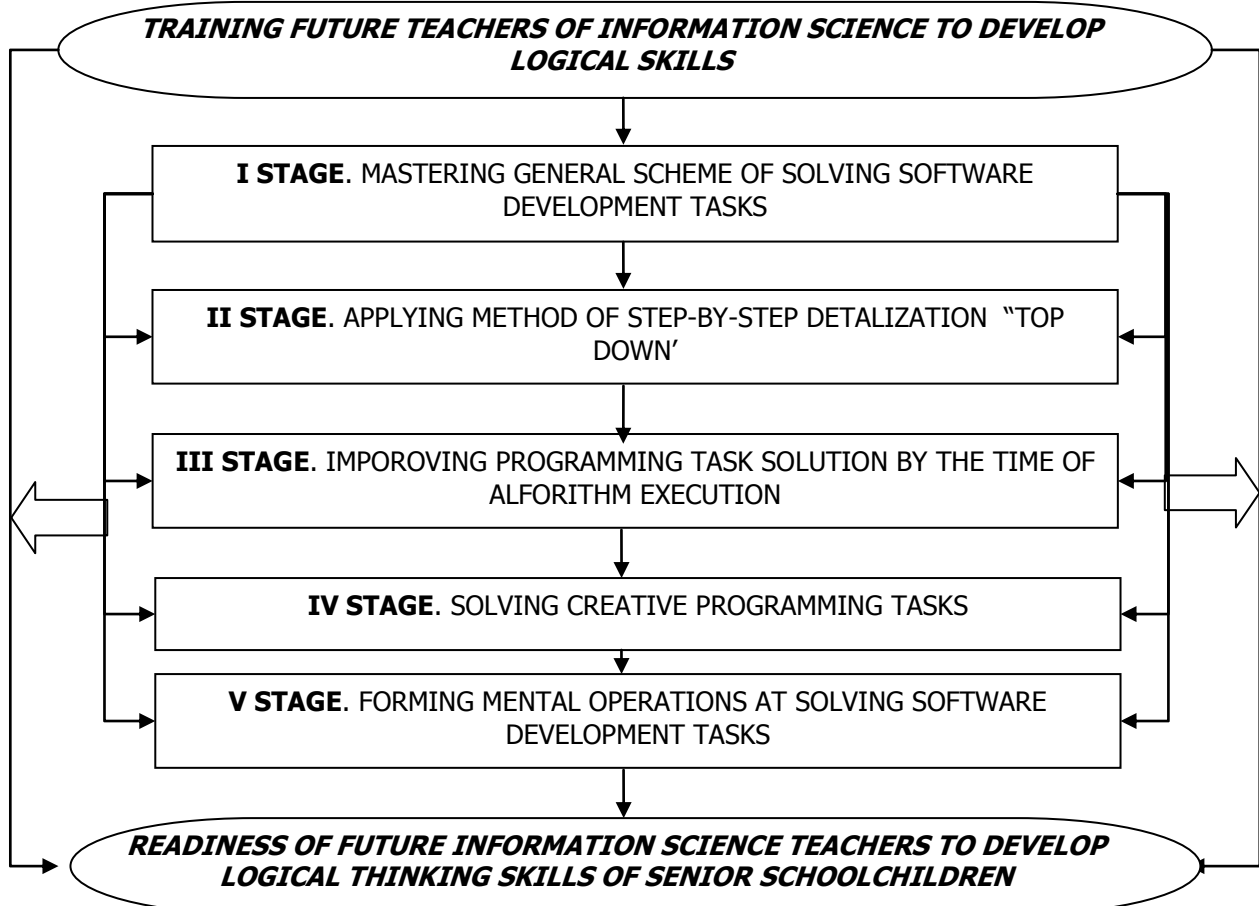


Fig. 1. The stages of training future teachers of Information Science to develop logical thinking of senior schoolchildren

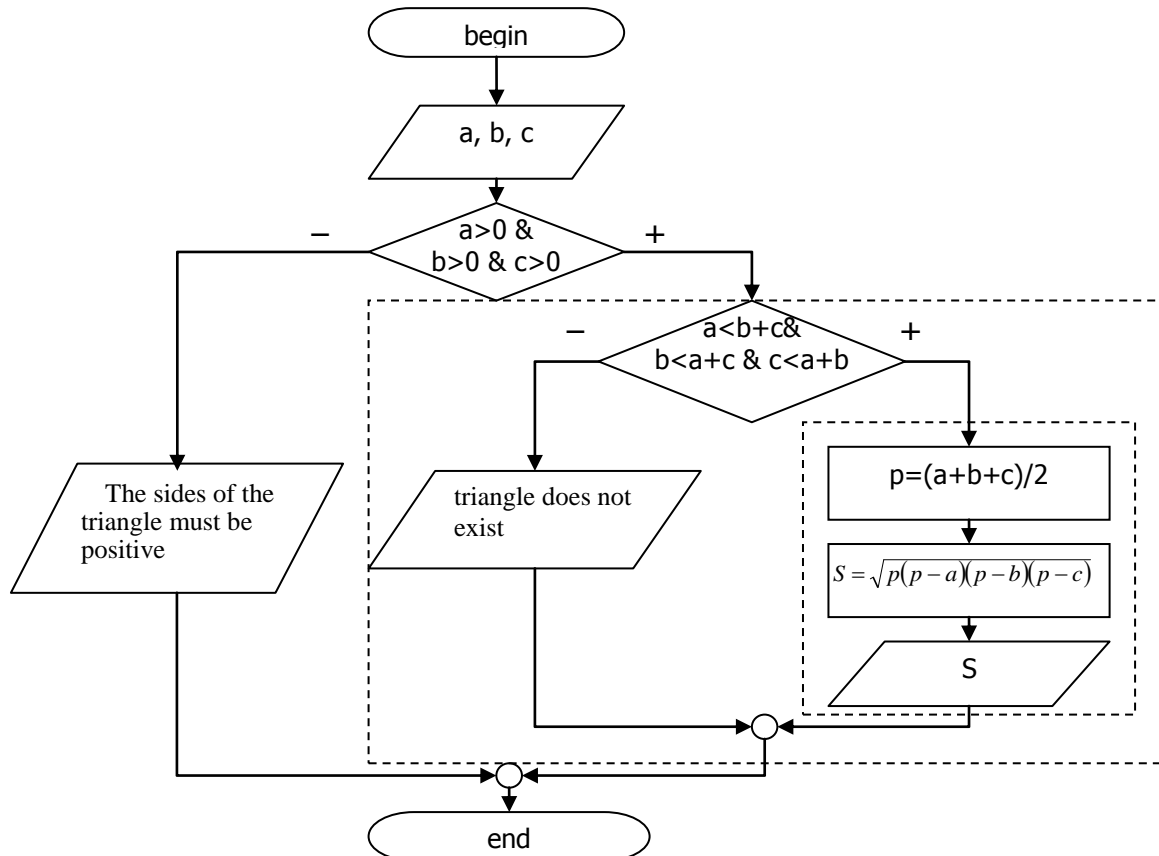


Fig. 2. Block diagram of the problem solving algorithm 1

**I stage. The application of the method of step-by-step “Top down”**

Such famous scientists as U. Dal & E. Deykstry & K. Hoor [1] consider it important to separate structural programming as methodology. Independently, they supported the cancellation of *goto* operator in programming and the improvement of *the theory of programming language* of general purpose. As a result, the methodology of *step-by-step program development* was suggested. The given methodology implies developing from global to local, general-to-specific, i.e. jumping into *algorithm top down*.

While building an algorithm, there is a necessity to explain some of the complex actions. This explanation can be based on the situations from everyday life. For instance, instructing a child how to clean a room at the first time, it is essential to explain how to do it, i.e. how to scrub, to dust, to fill a bucket with water and so on. After, there will be no need to explain it again, since a child has learned “chore algorithm”.

Taking into consideration all the mentioned above, it is possible to conclude, that every single task is a specific command for the executors, in case they know the algorithm of its performing. Applying this method leads to an algorithm which consists of simple commands. These commands can be either understood by the executor, or it can be inferred, that the selected executor is not able to solve this task. An example of it can be the explanation to a child how the plane is constructed, therefore, such task will be impossible to solve.

The proposed approach to develop algorithms is called *the method of step-by-step detalization top down* [2]. Here, every operation will be represented by the only one among three types of basic algorithm structures. They are: *linear* (following means that the operations are performed sequentially, one by one), *branching* (the specific operation execution depending on the condition) and *repetition* (a cycle makes repetition of the certain action many times). The level of detalization in the given case depends on knowledge, abilities and skills of an executor.

Let us consider the simplest algorithm of a person crossing the street. Every child seems to be familiar with this this command since childhood due to the fact, that the parents have explained the traffic rules many times. These rules have become for a child a certain algorithm: if one has to cross the street, it is necessary to look at traffic lights and cross the street following these rules; if there is no traffic lights, the rules of crossing the street without traffic lights should be followed. Both cases require detalization of the given algorithm, i.e. explanation of main rules of crossing the street with traffic lights or without them.

But there are many other cases, when the given situation is constantly complicated with non-stop sequence of questions which are difficult to understand, that is why it requires using subtasks of an algorithm. These subtasks are called auxiliary tasks. They appear at splitting a complex task into simple ones or when there is a need to repeat the same set of actions within one or different algorithms many times. The described method

of successive detalization is the basis of technology of structural development and is widely used at applying such programming languages as Pascal, C, C++ and others.

Auxiliary algorithms are implemented in the form of subprograms while describing a computer program by high-level programming languages. The rules can be used when needed and sent to the call site. They are determined with the certain programming language. To make it comfortable, it is possible to combine the frequently used subprograms into library modules and if it is necessary to use them in some programs.

The given stage is presented in detail in works by author [2]. As a result, students can obtain the skills and abilities of top-down programming. It will also help them to set out their ideas clearly, consistently, being able to explain their answers which are the basis of logical thinking development.

**III stage. The improvement of a development task solution by the time of algorithm execution**

The skills and abilities to improve the algorithms of task solution by time are the main aspects of future teachers training to develop the logical thinking skills of senior schoolchildren. The usage of knowledge in mathematics is one of the promising ways to solve the given problem.

Finding solutions to tasks for the certain period of time (an algorithm execution time is limited) is an essential requirement at competitions. The site [www.e-olymp.com](http://www.e-olymp.com) can serve as an example. It is used at competitions of different levels. Every task in the list of assignments is limited with time.

It is recommended to find a stable task for the given task. The solution of the stable task will be much faster than the initial one. Therefore, the task is significantly simplified; the execution of the algorithm becomes faster. Similar approach to a software development task analysis will allow improving its solution algorithm by time.

The third stage demonstrates the students' level to improve task solution by mathematical tools (the abilities to formulate and select from alternative hypotheses, to simplify an algorithm by improving task solution in contrast to formal overlearning are developed). It definitely improves the development of logical thinking.

**IV stage. Solving creative software development tasks**

Let us assume that *the creative software development task* is a task that requires searching and building an algorithm to its solution by existing methods with further implementation by a programming language. Here the students acquire new knowledge, obtain new abilities and skills; develop abstract and logical thinking, creative abilities, and cognitive interest.

While solving such tasks, a teacher initiates creativity and discussion related to finding solution. The discussions can be either with peers or with the teacher, students have to explain and think over it and all this develops logical thinking.

The fourth stage demonstrates the forming of student skills and abilities to solve creative tasks and it contributes much to their mental development, namely, being to classify and to systematize. Discussions provide creativity in finding solution; students explain their answer and think over it.

**V stage. Forming mental operations at software development task solving.** Let us consider the details of forming mental operations in the process of solving software development tasks. Let us take the given task.

**Task 1.** Develop the task to find LCM of two natural numbers.

Task statement (its analysis). There are two natural numbers: a and b. The task is to find their LCM.

The search of solution algorithm. Students suggest finding LCM by using LCD in the given case. It is due to the fact, that they know the formula  $LCM(a,b)=|a*b|/LCD(a,b)$ .

Here students separated the dependence of LCM on LCD and it demonstrates using synthesis and abstracting.

Now students suggest various ways to find LCD starting from direct selection and finishing with Euclid algorithm. At the same time students search the alternative ways of task solution, discussing about the best algorithm and in such way showing creativity. Such mental operations as comparison and generalization are being developed in the process of discussion.

Therefore, it is necessary to highlight the operations being developed as well as the stage of their development in order to form logical thinking of students. It will help them to develop logical thinking skills of senior schoolchildren in their future professional activity. The alibies to be formed at creation process have to be mentioned also.

As we can see, all mental operations and the required skills and abilities are formed in the process of implementation of suggested stages at training future teachers of Information Science to develop logical thinking of senior schoolchildren. These skills and abilities are indispensable for the development of logical thinking.

**Conclusions.** Therefore, the suggested stages of future teachers training to develop logical thinking of senior schoolchildren allow teaching students how to develop logical thinking of children in their professional activity. It also will help to unlock their creativity. Every stage demonstrates forming elements required to develop logical thinking.

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